Bacterial Genotypes and Plating

Overview:

Two types of bacterial cells genes are nutrient genes and toxin resistance genes. These two types of genes control which conditions a bacterial cell can survive in. To be resistant to a toxin, a bacterial cell needs a functional wildtype version of the specific toxin resistance gene. Not all bacterial cells can survive in an environment with toxin; bacterial cells that are susceptible to a toxin are those who would die from it. Bacterial cells also need amino acid nutrients to survive and make life sustaining proteins. Sometimes a bacteria can get all nutrients from their environment. If they cannot, in order to live, the bacteria must make any nutrient that is not available to it in the environment. Making any nutrient requires a wildtype, functional allele of the specific nutrient gene.

Analogies:

Many professors use analogies to explain how bacterial genotypes work. Dr. Beck describes nutrient genes with bakery goods. Let's say you need cookies, cupcakes, and brownies to survive in your house. There are two options, a person could already have them in their home, or they may be capable of baking them. Not everyone has a recipe for all three goodies, so they may not be able to make them. If your house only has cookies and cupcakes, the only way you can survive is if you have a recipe and then make brownies. If you cannot make brownies and do not have brownies in your home, you die. If you also have a recipe for cookies but they already exist in your home, you can just hold onto your recipe to use for later. In this analogy, each bakery good represents a different nutrient. The recipe for a specific food represents a functional allele for a specific nutrient gene.

To understand toxin resistance, let's use an analogy featuring snake venom. Some people may have a bottle of antivenom in their fridge specific for a rattlesnake, but not everyone does. Anyone walking in the grass has a chance of being bitten by a rattle snake. If you are bitten, you need the antivenom to survive. If you are not bitten, antivenom is not needed. The antivenom vial may help you at a later time survive a bite. In this example, snake bites and the venom you are subjected to represents a toxin from the environment. A toxin resistance gene codes for an antivenom while being susceptible to the toxin represents not having access to antivenom.

Summary:

To summarize, a bacteria can have genes to make necessary nutrients. For any nutrients not available in the environment, a bacteria must have a functional nutrient gene so they can make it, otherwise they die. When a nutrient is supplied in the environment, it does not matter if a bacteria has a wildtype gene for that nutrient; they can use the nutrient from their environment regardless of their genotype. In an environment with a toxin, only bacteria with a toxin resistance gene survive. When there is no toxin in the environment, it does not matter if the bacteria have a toxin resistance gene because they do not need to use it.

Nutrient genes are written as a three-letter abbreviation of the amino acid and the superscript denotes a wildtype or mutant allele for the gene. For example, the nutrient gene for methionine is abbreviated as met. A bacteria with met^+ has a functional wildtype copy of this nutrient gene and can make methionine on their own while a bacteria with met^- has a mutant copy and cannot make methionine. Superscript R and S denote resistance and susceptibility to toxins. Streptomycin resistance genes, for instance, would be denoted as Str^R while a bacterium that is susceptible to streptomycin toxin would have Str^S in its genotype.

Learning Objectives:

- Understand how nutrient genes and toxin resistance genes work in bacteria.
- Be able to read a bacterial genotype and predict which nutrients must be available in the environment for it to survive.
- Understand how plating on selective media works.
- Predict the genotype of bacteria given data about which plates it grows on.

Order of Activities:

1. Read this overview to understand selective media: https://www.labxchange.org/library/pathway/lx-pathway:f9cf312c-f9ec-4918-a804-b9cb06fbd46b/items/lx-pb:f9cf312c-f9ec-4918-a804-b9cb06fbd46b:html:185eb386
2. Test yourself by completing the corresponding worksheet for this material. Attempt to first complete this on your own, then pair up with a partner or group to discuss when possible. There is an answer key provided so you can check your work and read through all explanations for the questions. Any questions you get wrong or confused about you should attempt to explain why the answer is correct and then complete again after you finish the activities in this guide.
3. After reviewing any topic, it is a good idea to have a metacognition check. Ask yourself the following questions:
    - What are my emotional responses to learning this material? Which material am I frustrated with and need aid in understanding?
    - What difficulties have I had with the learning tasks? What specific tasks will I do to master this content?
    - Do I understand all of the learning goals? Can I explain each of them out loud to someone clearly and concisely?
    - How is what I learned related to other things I have learned in this class? How is it related to other classes, my career, and my life?
4. Closing activity: Review the three types of horizontal gene transfer and imagine how plating techniques could be used in a lab to test for each.
5. If you would like to have more aid in learning this material, please reach out. There are numerous individuals who want to help you feel confident in your understanding. If your course has learning assistants or teaching assistant(s), you should reach out to them to review concepts you want to learn more about. Your professor is also a great resource to go to when you do not understand a topic. You can study with your peers or receive academic support through the LRC as well. If you would like help identifying how to receive the support you need, do not hesitate to contact the CU Denver Learning Resources Center at LRC@ucdenver.edu or stop by our front desk in the learning commons building.